Automatic Drip Irrigation Unit using Pic Controller

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***Abstract* - In the field of agriculture, use of proper method of irrigation is important and it is well known that drip irrigation is very economical and efficient. In the conventional drip irrigation system, the farmer has to continuously monitor the soil and weather conditions in favor of growth of crops. In this project, temperature sensor and moisture sensor are used to measure the soil and weather conditions of the field. The temperature and moisture values from the sensors are sensed to the microcontroller and thus the current temperature and moisture are compared with predefined values. According to the temperature and moisture value, required amount of water is supplied to the crops. The sensed temperature and moisture will be displayed in the liquid crystal display.**

***Keywords* - drip irrigation, sensors, microcontroller, and moisture**.

I.INTRODUCTION

The continuous increasing demand of the food requires the rapid improvement in food production technology. In India, the economy is mainly based on agriculture; still we are not able to make full use of agricultural resources. The main reason is the lack of rain and scarcity of land reservoir water. Another very important reason of this is due to unplanned use of water due to which a significant amount of water goes waste. At the present, the farmers have been using irrigation technique in India through the manual control in which the farmers irrigate the land at the regular intervals. This process consumes more water or sometimes water reaches the root late due to which the crops get dried.

This problem can be perfectly rectified if we use automatic micro controller based drip irrigation system in which the irrigation will take place only when there will be intense requirement of water. In the modern drip irrigation systems, the most significant advantage is that water is supplied near the root zone of the plants due to which a large quantity of water is saved in [1].Using the temperature sensor and moisture sensor, the requirement of water to the crop can be sensed and its measurements in [2] are displayed in the LCD Display using PIC controller. According to the requirements of the crop, water is allowed to flow through the pump. The software used is MPLAB IDE v8.50 and Tiny Boot loader. MPLAB IDE v8.50 is used for programming the Programmable Interrupt Controller (PIC) in C Language. Tiny Boot loader is used to write the program in the program memory of the chip.

II. DRIP IRRIGATION UNIT

The important parameters to be measured for automation of irrigation system are soil moisture and temperature. The entire field is first divided into small sections such that each section should contain moisture sensor and a temperature sensor. LM35 in [3] can be used as a temperature sensor while Soil moisture sensor in [4] can be used to detect moisture contents of soil. The temperature sensors are placed at the different locations of the field. The

moisture sensors are buried in the ground at required depth. Once the soil has reached desired moisture level the sensors send a signal to the micro controller. If the moisture content in the field gets reduced in the field, the signal is produced through controller. Water from the source is pumped using the pump which is stored in the tank in [5]. The temperature level and moisture level sensed from the sensor will be displayed in the LCD display. The water is supplied drop by drop to the root of the plant. After reaching desired moisture level, the sensor gives corresponding signal to the controller. Hence the yielding of crop is high and the water usage is low.

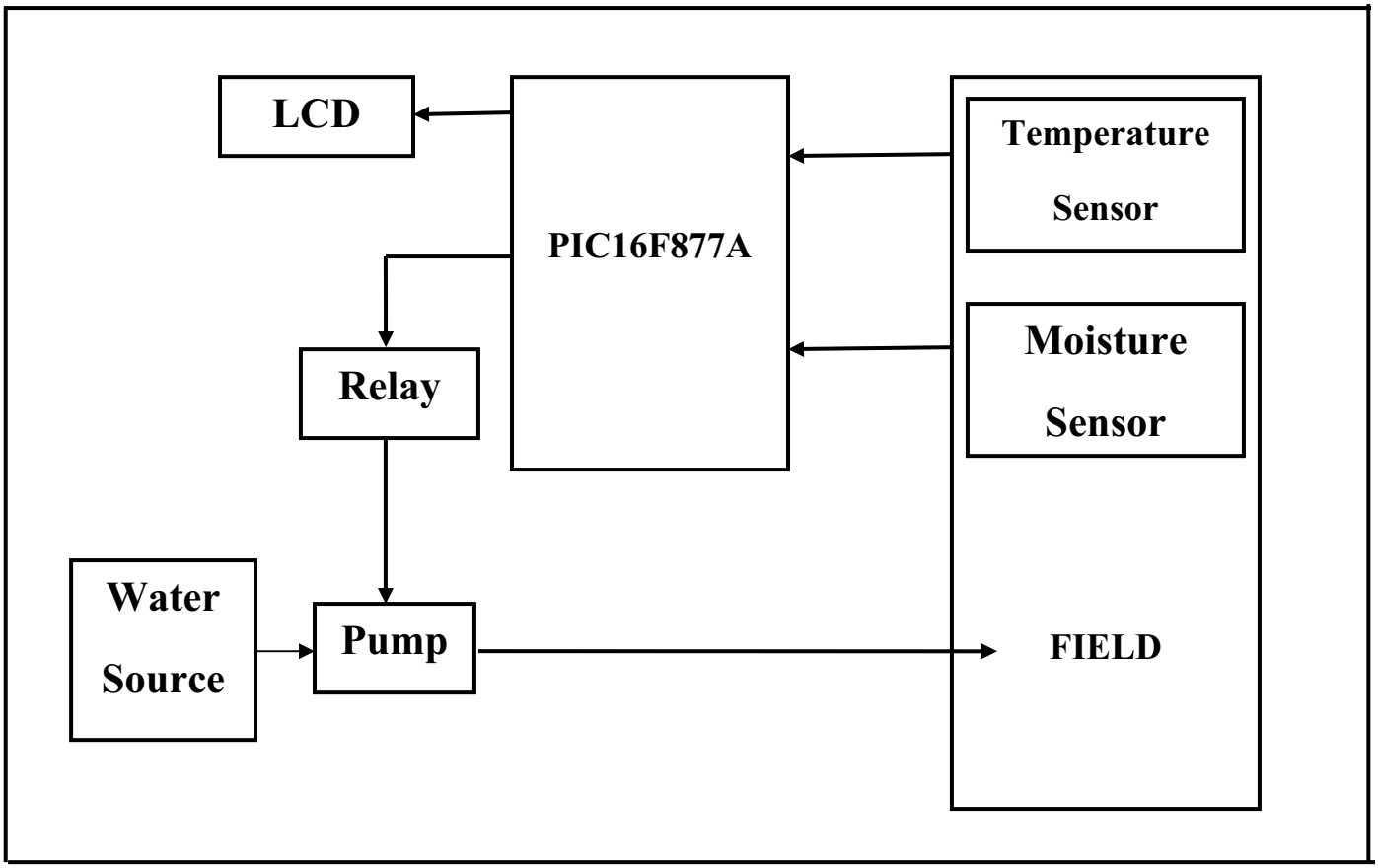


Figure 1. Layout of the drip irrigation unit

III. STUDY OF CROPS

The requirements for growth of various crops at the different seasons were studied. The temperature and moisture are two basic parameters which influences the growth of the crop. Hence the importance is given to both of this parameter. Each crop requires different temperature and moisture levels at various stages. But there is an optimum range of values in [7]. The temperature and moisture are the inter-related parameter. When the soil temperature increases, soil moisture decreases. Hence the comparison of these both parameter can be used for the better yield of crops. The temperature and moisture level of the various crops such as rice, wheat, bajra in [11], sugarcane were studied.

IV. HARDWARE DESCRIPTION

AUTOMATIC DRI P IRRIGATION UNIT USING MICROCONTROLLER can be used universally for various types of crops. The current drip irrigation unit is designed for three different crops such as rice, wheat, bajra. On power up of the unit, there is a facility for the selection of crop by using switches. On pressing the corresponding

switch the particular crop is selected. Then the soil temperature and soil moisture is displayed continuously in the liquid crystal display (LCD).

A.Selection of crops

Four switches are connected to the PORTD of the controller. PORTD is configured as the input port. Based on the switch input to the port the program enters the corresponding loop where the current temperature and moisture will be compared with the predefined values.

When switch 1 is pressed, the rice crop is selected. The predefined set of values stored for the rice crop will be taken as the reference values and comparison is made. Similarly switch 2 is dedicated to wheat crop and switch 3 for bajra

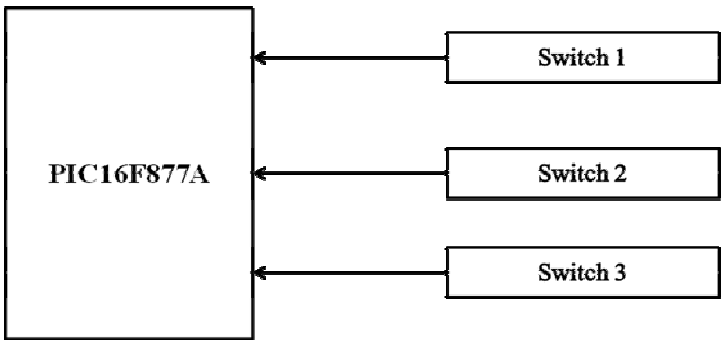
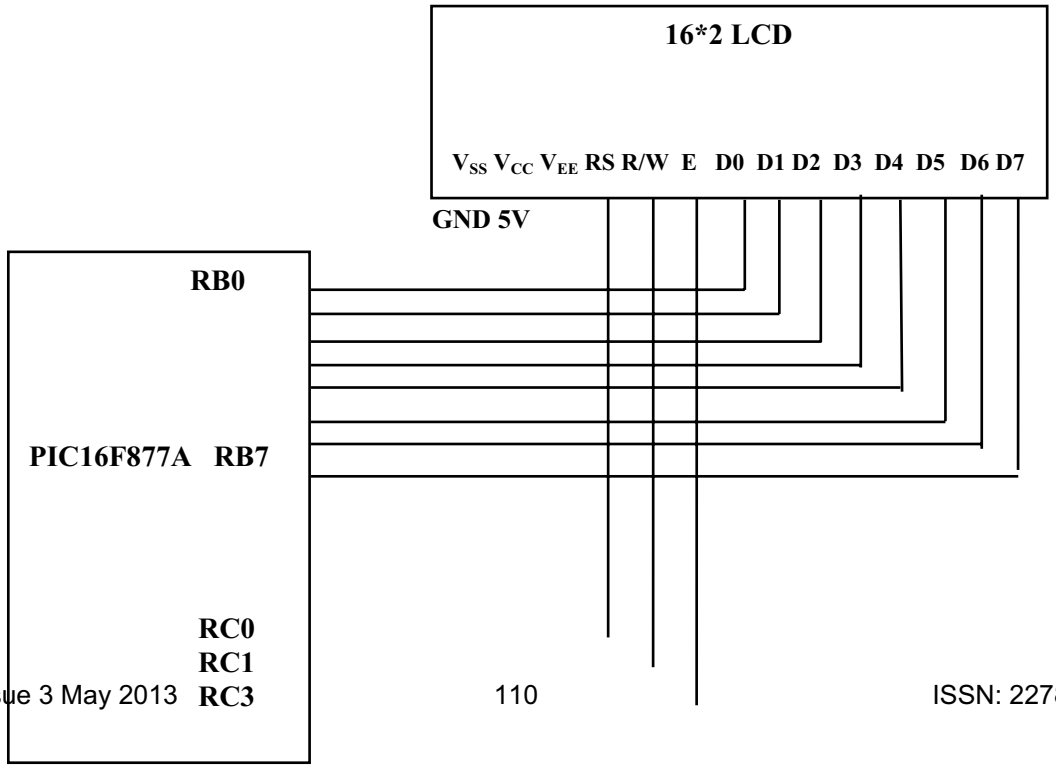


Figure 2 Switch arrangement

B. Liquid crystal display

The LCD will display the alphabets, numbers, characters and symbols. The LCD used here is eight bit parallel type and the display size is 16*2. Liquid Crystal Display is used for displaying the temperature and moisture value.LCD consists of three control pins and eight data pins. Based on the commands given to the control pins, data can be read from or write to the LCD.The eight data pins of the LCD are connected to the PORTB pins RB0-RB7. Three control pins are connected to PORTC pins. RC0, RC1, RC2 are used for register select (RS), read/write (R/W) and enable (E) respectively.



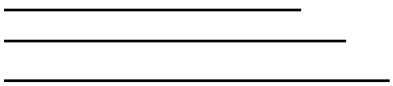


Figure.3 Interfacing LCD with PIC16F877A

Initially the display is cleared and the cursor is placed at the first character of the first line. Then the data to be displayed is sent to the LCD. LCD accepts only the ASCII values as input. Hence the hexadecimal values are converted into ASCII values and it is fed to the LCD to display the temperature.V_{CC} and V_{SS} are provided with 5V and ground respectively.V_{EE} is used for controlling LCD contrast.

C. Sensor interfacing

The LM35 sensor is used to measure the temperature and to measure the moisture.The LM35 series sensors are precision integrated-circuit temperature sensors whose output voltage is linearly proportional to the Celsius temperature. The LM35 requires no external calibration since it is internally calibrated. The LM35 precision centigrade temperature sensor is an analog sensor. The analog output voltage from the LM35 is linearly proportional to temperature in Celsius. Hence there is no requirement for the external calibration. The PIC microcontroller consists of inbuilt analog to digital converter. The PORTA and PORTE are configured as the analog input channels. The output is fed to the channel 1(RA0). The digital output is thus converted will be available for the further process in special registers ADRESH and ADRESL. Since the ADC is having 10-bit resolution, it must be converted into 8-bit and then the output is fed to the LCD.

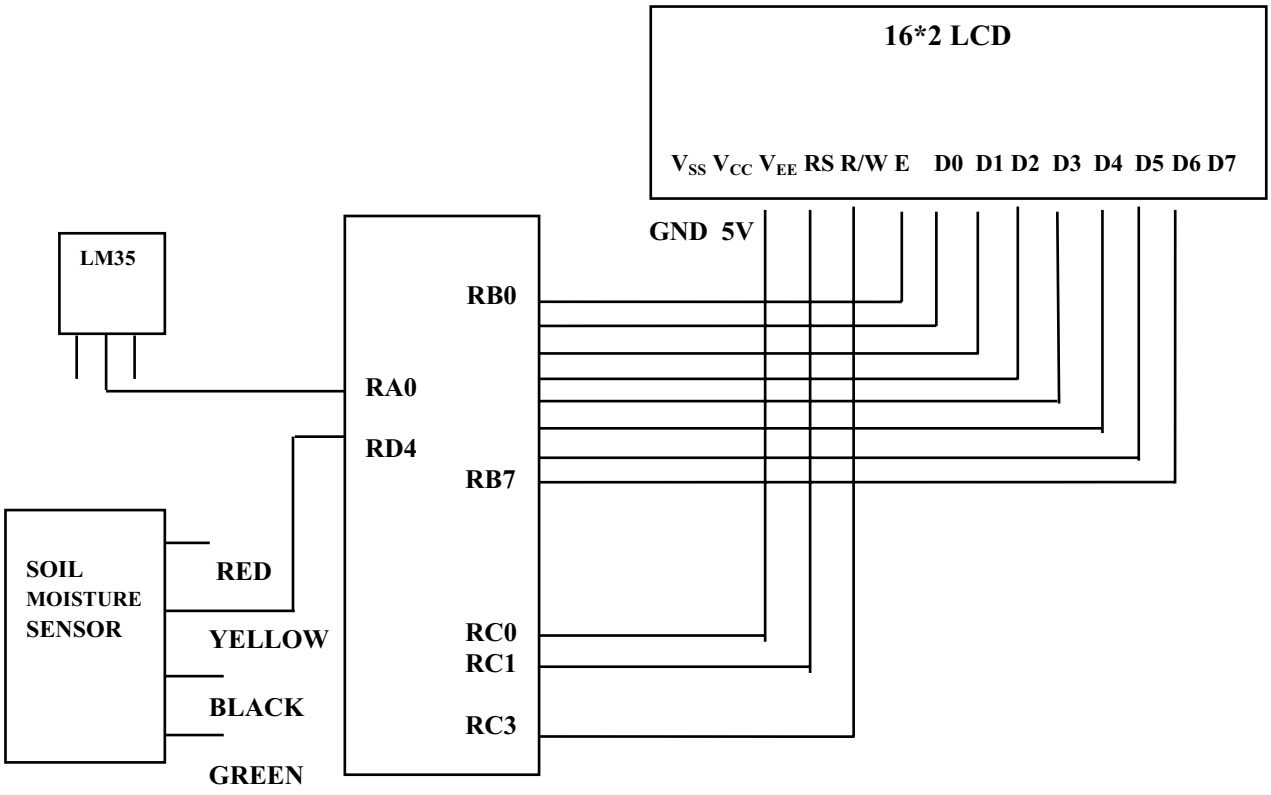


Figure.4 Interfacing sensor with PIC16F877A

V. PUMP AND RELAY UNIT

Relay along with transistor is used to turn on/off the pump. Transistor BC547 acts as a switching device. The collector is permanently connected to the DC 12V which provides coil voltage for relay.

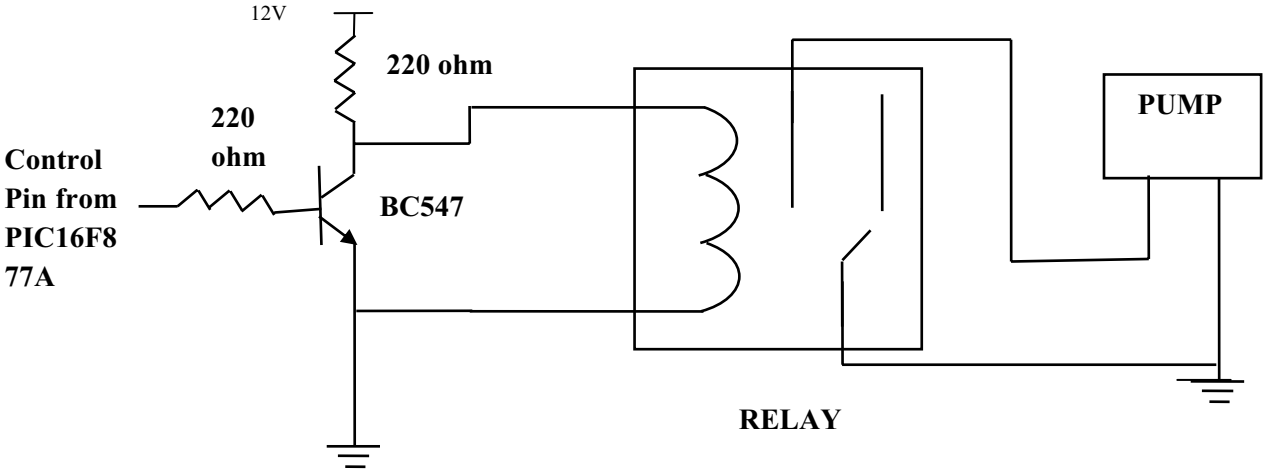


Fig.5 Interfacing Pump with Relay Unit

The emitter is grounded. When the supply is given to the base of the transistor, it turns on the relay and when the supply is cut-off, the relay is turned off. The supply voltage required for the load connected (pump) to the relay should be given to the common pin.

VI. SOFTWARE DESCRIPTION

MPLAB IDE is the software used for programming PIC microcontroller through embedded C. TINY Boot loader is used to download the program in to the flash of the PIC.

A. MPLAB IDE

MPLAB IDE is a Windows Operating System (OS) software program that runs on a PC to develop applications for Microchip microcontrollers and digital signal controllers. It is called an Integrated Development Environment, or IDE, because it provides a single integrated "environment" to develop code for embedded microcontrollers.

A development system for embedded controllers is a system of programs running on a desktop PC to help write, edit, debug and program code - the intelligence of embedded systems applications - into a microcontroller. MPLAB IDE runs on a PC and contains all the components needed to design and deploy embedded systems applications.

B.PROTEUS ISIS

PROTEUS allows engineers to run interactive simulations of real designs for circuit simulation. It has a range of simulator models for popular micro-controllers and a set of animated models for related peripheral devices such as LED and LCD displays, keypads and more. It is possible to simulate complete micro-controller systems and thus to develop the software for them without access to a physical prototype.

It have simulated our hardware model using the software Proteus ISIS. The simulator models such as PIC16F877A, LED, LCD display, Switches, pot, Relay, Resistors, Transistor and sources were used and results were verified with hardware results.

C.TINY BOOT LOADER

Tiny is a boot loader for the Microchip PIC microcontrollers. It is the smallest boot loader, taking less than 100 words of program space. Supports families of PIC devices: 16F, 18F, dsPIC30 (those devices that support self-programming).

VII. RESULTS

The output of LM35 - Precision Centigrade Temperature Sensor is in the form of analog. The input supply voltage is 5 volts. The output will be in the form of voltage. The room temperature is 29 degree Celsius. The output will be in millivolts, 290 millivolts. This analog is converted to digital data through ADC0808. It is directly connected to microcontroller. Its calibration is simple and easy. The output value of temperature sensor is displayed in the LCD.

Table 1 : Output of the LM35 - Precision Centigrade Temperature Sensor

Temp(^{o}C)	**Vout (mv)**
27	270
28	280
29	290
30	300
31	310
32	320
33	330

The soil moisture sensor is directly connected to the microcontroller. The input supply voltage given to the sensor is 3-10 volts. The output voltage is in digital form. The digital data is directly sent to the controller. The value is displayed in the LCD.

Table 2: Output of the Soil Moisture Sensor

RH (%)	***Vout(mV)***
10	1325
20	1600
30	1860
40	2110
50	2360
60	2605
70	2860
80	3125
90	3405
95	3555

According to the moisture level of field, the water is supplied to the field. If the moisture level of the field is low, then the water is flowed to the field. When it reaches the level, automatically microcontroller closes the valve in [10]. The water source to plants and shrubs at a carefully controlled rate by a means of flexible tubing with tiny drippers, sprayers, hoses, and bubblers attached to it. This system is economical, efficient and automated.

VIII. CONCLUSION

The Microcontroller based drip irrigation system monitors and controls all the activities of drip irrigation system efficiently. The moisture of the soil and the temperature of the surroundings will be measured and water is supplied to the crop accordingly which prevents water clogging. This system saves water because the water is directly fed to the root and the quality of the crop gets improved. It also helps in time saving, removal of human error in adjusting available soil moisture levels and to maximize their net profits.

IX. FUTURE WORK

Water resources can be utilized efficiently and effectively based on various other parameters so that agricultural sector becomes more productive. Automatic drip irrigation at different seasons is another future scope. Water is allowed to the field of crops depending upon the particular season. Some more parameters such as plant growth at different stages,wheather condition are to be taken into account to determine the water requirement for the crop This will improve agriculture leading to economical development of our nation.

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